CLAIMS

What is claimed is:

1. A catheter assembly for introducing fluid into a vessel, the catheter assembly comprising:

(a) a shaft;

(b) a hub affixed to a proximal end of said shaft;

(c) a stem affixed to a distal end of said shaft, said stem having a porous section approximate a distal end thereof, said porous section defining a plurality of microholes generally distributed uniformly thereabout and inclined by a predetermined angle in a proximal direction; and

(d) a tip affixed to said distal end of said stem, said tip including a conically-shaped valve with an apex thereof defining an opening and pointing in the proximal direction;

such that, as the fluid flows within said catheter assembly and pressure increases within said tip, said conically-shaped valve dynamically changing and thus generally decreasing a size of said opening so that the amount of the fluid flowing out of (A) said opening of said tip decreases and (B) said microholes of said stem increases, with the forces of the fluid flowing out of said microholes and said opening substantially balancing thereby enabling a position of said tip and said stem within the vessel to remain stable while fluid is finely dispersed therefrom.

2. The catheter assembly of claim 1 wherein an outer part of said tip is made of a nylon in a range approximately from 25D nylon to 55D nylon.

35D nylon.

4. The catheter assembly of claim 1 wherein a length of said tip ranges approximately from 1 mm to 10 mm.

5. The catheter assembly of claim 4 wherein said length of said tip ranges from approximately 1 mm to 2 mm.

6. The catheter assembly of claim 1 wherein a size of said opening of said conically-shaped valve ranges approximately from 0.889 mm at a base thereof to 0.1016 mm at said apex in absence of fluid pressure.

7. The catheter assembly of claim 6 wherein said size of said opening at said apex is approximately in the range of 0.220 mm to 0.260 mm.

8. The catheter assembly of claim 1 wherein said conically-shaped valve includes:

(a) a circular base portion affixed to approximately a distal end of said tip; and

(b) a conical wall portion extending and decreasing in thickness from said circular base portion to said apex.

therein ranges from approximately 0.889 mm at said circular base portion to approximately 0.1016 mm at said apex in absence of fluid pressure.

10. The catheter assembly of claim 6 wherein said size of said opening at said apex is approximately in the range of 0.220 mm to 0.260 mm.

11. The catheter assembly of claim 1 wherein a difference in a size of said opening of said conically-shaped valve between an absence of pressure and a maximum pressure within said tip ranges approximately from 0.0762 mm to 0.127 mm.

12. The catheter assembly of claim 1 wherein a difference in a size of said opening of said conically-shaped valve between an absence of pressure and a maximum pressure depends on at least one of a shape of said valve and a thickness of a wall portion of said valve.

13. The catheter assembly of claim 1 wherein said conically-shaped valve is made of a material(s) sufficiently pliable to enable passage of a guidewire therethrough but to avoid everting under the pressure extant within said tip.

14. The catheter assembly of claim 1 wherein said stem is made of a nylon in a range approximately from 45D nylon to 75D nylon.

16. The catheter assembly of claim 1 wherein said predetermined angle depends on at least one of a size of said catheter assembly, a shape of said catheter assembly, a desired volume of the fluid to be introduced into the vessel, and a ratio of an amount of the fluid to be flowing out of said microholes to that to be flowing out of said opening.

17. The catheter assembly of claim 1 wherein said predetermined angle by which said microholes of said porous section are inclined ranges approximately from 0 to 45 degrees.

18. The catheter assembly of claim 17 wherein said predetermined angle by which said microholes of said porous section is inclined is approximately 20 degrees.

19. The catheter assembly of claim 17 wherein said predetermined angle by which said microholes of said porous section is inclined changes with position along said stem.

20. The catheter assembly of claim 1 wherein a size of said microholes is in a range approximately from 5 microns to 250 microns.

21. The catheter assembly of claim 20 wherein said size of said microholes is approximately 50 microns.

22. The catheter assembly of claim 1 wherein said microholes are distributed about said porous section according to a pattern having a plurality of pairs of longitudinally arranged rows, with each of said row pairs being laterally spaced generally equidistantly from its neighbors.

23. The catheter assembly of claim 1 wherein a diameter of said microholes of said porous section changes with position along said stem.

24. The catheter assembly of claim 1 wherein said catheter assembly is for use with a guidewire.

25. The catheter assembly of claim 1 wherein said catheter assembly permits measurement of pressure extant in the vessel.

26. The catheter assembly of claim 1 further comprising a strain relief element interconnected between said hub and said proximal end of said shaft.

27. The catheter assembly of claim 1 wherein a ratio of the fluid flowing out of said opening to that out of said microholes is approximately 25% and 75%, respectively, when the pressure of the fluid has flattened out said conically-shaped valve.

opening to that out of said microholes is between approximately 10% and 90%, respectively, and 49% and 51%, respectively, when the pressure of the fluid has flattened out said conically-shaped valve.

29. A catheter assembly for introducing fluid into a vessel, the catheter assembly comprising:

(a) a stem having approximate a distal end thereof a porous section defining a plurality of microholes distributed thereabout and inclined by a predetermined angle in a proximal direction; and

(b) a tip affixed to said distal end of said stem, said tip including a conically-shaped valve with an apex thereof pointing in the proximal direction and defining an opening whose size generally decreases as said conically-shaped valve dynamically changes as pressure of the fluid within said tip increases;

wherein the forces of the fluid flowing from within said catheter assembly out of said opening of said tip and out of said microholes of said stem substantially balance thereby substantially eliminating both recoil and whipping of said catheter assembly thus enabling a position thereof within the vessel to remain stable while the fluid is finely dispersed therefrom.

30. The catheter assembly of claim 29 wherein said stem is made of a nylon in a range approximately from 45D nylon to 75D nylon.

31. The catheter assembly of claim 30 wherein said stem is made of 63D nylon.

32. The catheter assembly of claim 29 wherein said microholes are uniformly distributed about said porous section according to a pattern having a plurality of pairs of longitudinally arranged rows, with each of said row pairs being laterally spaced generally equidistantly from its neighbors.

33. The catheter assembly of claim 29 wherein said microholes are radially distributed about said porous section uniformly and according to a gradient along a longitudinal axis thereof.

34. The catheter assembly of claim 33 wherein said microholes along the longitudinal axis are deployed in a plurality of sections of substantially equal length wherein the number of said microholes in each of said sections changes according to a linear progression.

35. The catheter assembly of claim 34 wherein said plurality of sections includes a proximal section having a fewest number of microholes, a middle section having double the number of microholes in said proximal section, and a distal section having triple the number of microholes in said proximal section.

36. The catheter assembly of claim 29 wherein said microholes are distributed about said porous section according to a pattern having a plurality of laterally-spaced spiral formations.

37. The catheter assembly of claim 29 wherein said predetermined angle depends on at least one of a size of said catheter assembly, a shape of said catheter assembly, a desired volume of the fluid to be introduced into the vessel, and a ratio of an amount of the fluid to be flowing out of said microholes to that to be flowing out of said opening.

38. The catheter assembly of claim 29 wherein said predetermined angle by which said microholes of said porous section are inclined ranges approximately from 0 to 45 degrees.

39. The catheter assembly of claim 38 wherein said predetermined angle by which said microholes of said porous section is inclined is approximately 20 degrees.

40. The catheter assembly of claim 38 wherein said predetermined angle by which said microholes of said porous section is inclined is approximately 0 degrees.

41. The catheter assembly of claim 38 wherein said predetermined angle by which said microholes of said porous section is inclined changes with position along said stem.

42. The catheter assembly of claim 29 wherein a size of said microholes is in a range approximately from 5 microns to 250 microns.

approximately 50 microns.

44. The catheter assembly of claim 42 wherein said size of said microholes is approximately 100 microns.

45. The catheter assembly of claim 29 wherein a diameter of said microholes of said porous section changes with position along said stem.

46. The catheter assembly of claim 29 wherein an outer part of said tip is made of a nylon in a range approximately from 25D nylon to 55D nylon.

47. The catheter assembly of claim 46 wherein said outer part of said tip is made of 35D nylon.

48. The catheter assembly of claim 29 wherein a length of said tip ranges approximately from 1 mm to 10 mm.

49. The catheter assembly of claim 48 wherein said length of said tip ranges approximately 1 mm to 2 mm.

conically-shaped valve ranges approximately from 0.889 mm at a base thereof to 0.1016 mm at said apex in absence of fluid pressure.

51. The catheter assembly of claim 50 wherein said size of said opening at said apex is approximately in the range of 0.220 mm to 0.260 mm.

52. The catheter assembly of claim 29 wherein said conically-shaped valve includes:

(a) a circular base portion affixed to approximately a distal end of said tip; and

(b) a conical wall portion extending and decreasing in thickness from said circular base portion to said apex.

53. The catheter assembly of claim 52 wherein a size of said opening of said tip therein ranges from approximately 0.889 mm at said circular base portion to approximately 0.1016 mm at said apex in absence of fluid pressure.

54. The catheter assembly of claim 53 wherein said size of said opening at said apex is approximately in the range of 0.220 mm to 0.260 mm.

of said conically-shaped valve between an absence of pressure and a maximum pressure within said tip ranges approximately from 0.0762 mm to 0.127 mm.

56. The catheter assembly of claim 29 wherein a difference in a size of said opening of said conically-shaped valve between an absence of pressure and a maximum pressure depends on at least one of a shape of said valve and a thickness of a wall portion of said valve.

57. The catheter assembly of claim 29 wherein said conically-shaped valve is made of a material(s) sufficiently pliable to enable passage of a guidewire therethrough but to avoid everting under the pressure extant within said tip.

58. The catheter assembly of claim 29 wherein said catheter assembly is for use with a guidewire.

59. The catheter assembly of claim 29 wherein said catheter assembly permits measurement of pressure extant in the vessel.

60. The catheter assembly of claim 29 further comprising:

(a) a shaft affixed to a proximal end of said stem;

(b) a strain relief element affixed to a proximal end of said shaft; and

61. The catheter assembly of claim 29 wherein a ratio of the fluid flowing out of said opening to that out of said microholes is approximately 25% and 75%, respectively, when the pressure of the fluid has flattened out said conically-shaped valve.

62. The catheter assembly of claim 29 wherein a ratio of the fluid flowing out of said opening to that out of said microholes is between approximately 10% and 90%, respectively, and 49% and 51%, respectively, when the pressure of the fluid has dynamically changed said conically-shaped valve.

63. A catheter assembly for introducing fluid into a vessel, the catheter assembly comprising a restrictor at a distal end thereof, said restrictor including a conically-shaped valve comprising:

(a) a circular base portion formed approximate a distal end of said restrictor; and

(b) a conical wall portion extending in a proximal direction from said circular base portion to an apex thereof, said apex defining an opening whose size generally decreases as said conically-shaped valve flattens out distally as pressure of the fluid within said restrictor increases.

64. The catheter assembly of claim 63 wherein said conical wall portion decreases in thickness in the proximal direction from said circular base portion to said apex.

approximately 0.889 mm at said circular base portion to approximately 0.1016 mm at said apex in absence of fluid pressure.

66. The catheter assembly of claim 65 wherein said size of said opening at said apex is approximately in the range of 0.220 mm to 0.260 mm.

67. The catheter assembly of claim 63 wherein a difference in a size of said opening of said conically-shaped valve between an absence of pressure and a maximum pressure within said restrictor ranges approximately from 0.0762 mm to 0.127 mm.

68. The catheter assembly of claim 63 wherein a difference in a size of said opening of said conically-shaped valve between an absence of pressure and a maximum pressure depends on at least one of a shape of said valve and a thickness of said conical wall portion.

69. The catheter assembly of claim 63 wherein said conically-shaped valve is made of a material(s) sufficiently pliable to enable passage of a guidewire therethrough but to avoid everting under the pressure extant within said restrictor.

70. A catheter assembly for introducing fluid into a vessel, said catheter assembly comprising:

plurality of microholes distributed thereabout and inclined by a predetermined angle in a proximal direction; and

(a) a restrictor affixed to said distal end of said stem, said restrictor defining an opening therein whose size generally decreases as pressure of the fluid within said restrictor increases;

wherein the forces of the fluid flowing from within said catheter assembly out of said opening of said restrictor and out of said microholes of said stem substantially balance to prevent axial and radial movement of said catheter assembly thus enabling a position thereof within the vessel to remain stable while the fluid is finely dispersed therefrom in a cloud-like form.

71. The catheter assembly of claim 70 wherein said microholes are generally distributed uniformly about said porous section both longitudinally along an axis thereof and radially about a circumference thereof.

72. The catheter assembly of claim 71 wherein said microholes are distributed according to a pattern having a plurality of pairs of longitudinally arranged rows, with each of said row pairs being laterally spaced generally equidistantly from its neighbors.

73. The catheter assembly of claim 71 wherein said predetermined angle by which said microholes of said porous section is inclined is approximately 20 degrees.

said porous section according to a pattern having a plurality of laterally-spaced spiral formations.

75. The catheter assembly of claim 74 wherein said porous section has two of said spiral formations each of which having a plurality of laterally-offset rows of microholes, with each of said rows in one of said spiral formations being diametrically opposite from a counterpart one of said rows in the other of said spiral formations.

76. The catheter assembly of claim 74 wherein said predetermined angle by which said microholes of said porous section is inclined is approximately 0 degrees.

77. The catheter assembly of claim 74 wherein said catheter assembly is implemented as one of a pigtail catheter and an other flush-type catheter.

78. A catheter comprising a distal segment having:

(a) a porous section; and

(b) a restrictor contiguous with said porous section, said restrictor defining an opening therein whose size generally decreases as pressure of fluid within said restrictor increases.

microholes distributed thereabout.

80. The catheter of claim 79 wherein a diameter of said microholes of said porous section changes with position along said stem.

81. The catheter of claim 79 wherein said microholes are inclined by a predetermined angle in a proximal direction.

82. The catheter of claim 81 wherein said predetermined angle by which said microholes of said porous section is inclined changes with position along said stem.

83. A catheter comprising a restrictor approximate a distal end thereof, said restrictor defining an opening therein whose size generally decreases as pressure of fluid within said restrictor increases.

84. A catheter comprising:

(a) a shaft; and

(b) a stem affixed to a distal end of said shaft, said stem having a porous section defining a plurality of microholes.

approximately from 5 microns to 250 microns.

86. The catheter of claim 84 wherein said size of said microholes is approximately 50 microns.

87. The catheter of claim 84 wherein a diameter of said microholes of said porous section changes with position along said stem.

88. The catheter of claim 84 wherein a size of said microholes is in a range approximately from 5 microns to 125 microns.

89. The catheter of claim 84 wherein said microholes are uniformly distributed about said porous section of said stem.

90. The catheter of claim 84 wherein said microholes are radially distributed about said porous section uniformly and according to a gradient along a longitudinal axis thereof.

91. The catheter of claim 84 wherein said microholes are radially distributed about said porous section uniformly and longitudinally distributed via a plurality of sections of substantially equal length wherein the number of said microholes in each of said sections changes according to a linear progression.

92. The catheter of claim 91 wherein said plurality of sections includes a proximal section having a fewest number of microholes, a middle section having double the number of microholes in said proximal section, and a distal section having triple the number of microholes in said proximal section.

93. The catheter of claim 84 wherein said microholes are distributed about said porous section according to a pattern having a plurality of laterally-spaced spiral formations.

94. The catheter of claim 93 wherein said porous section has two of said spiral formations each of which having a plurality of laterally-offset rows of microholes, with each of said rows in one of said spiral formations being diametrically opposite from a counterpart one of said rows in the other of said spiral formations.

95. The catheter of claim 84 wherein said microholes are deployed about said porous section such that the forces of fluid flowing from within said catheter out said microholes thereof in a finely dispersed, cloud-like form are substantially balanced thereby substantially eliminating movement of said catheter and thus enabling a position thereof to remain exceptionally stable.

96. The catheter of claim 95 further including a restrictor attached to a distal end of said stem, said restrictor acting as a plug thereat and thus preventing flow therefrom.

said stem, said restrictor acting as a plug thereat and thus preventing flow therefrom.

98. The catheter of claim 84 further including a restrictor at a distal end thereof contiguous with said porous section, said restrictor defining an opening therein whose size generally decreases as pressure of fluid within said restrictor increases.

99. The catheter of claim 98 wherein said microholes are generally distributed uniformly about said porous section and inclined by a predetermined angle in a proximal direction such that the forces of fluid flowing from within said catheter out of said opening of said restrictor and out of said microholes of said porous section substantially balance thereby substantially eliminating movement of said catheter thus enabling a position thereof to remain exceptionally stable while the fluid is finely dispersed therefrom.

100. The catheter of claim 99 wherein said predetermined angle depends on at least one of a size of said catheter, a shape of said catheter, a desired volume of the fluid to be injected, and a ratio of the fluid to be flowing out of said microholes to that to be flowing out of said opening.

101. The catheter of claim 99 wherein said predetermined angle by which said microholes of said porous section is inclined ranges approximately from 0 to 45 degrees.

microholes of said porous section is inclined is approximately 20 degrees.

103. The catheter of claim 101 wherein said predetermined angle by which said microholes is inclined changes with position along said stem.

104. The catheter of claim 99 wherein a size of said microholes is in a range approximately from 5 microns to 250 microns.

105. The catheter of claim 104 wherein said size of said microholes is approximately 50 microns.

106. The catheter of claim 99 wherein a size of said microholes is in a range approximately from 5 microns to 100 microns.

107. The catheter of claim 84 further including a restrictor at a distal end thereof contiguous with said porous section, said restrictor being manifested as a hemispheric cap that defines an opening at a distal end thereof.

108. The catheter of claim 107 wherein said microholes are generally distributed uniformly about said porous section and inclined by a predetermined angle in a proximal direction such that the forces of fluid flowing from within said catheter out of said opening of

substantially eliminating movement of said catheter thus enabling a position thereof to remain exceptionally stable while the fluid is finely dispersed therefrom.

109. The catheter of claim 108 wherein said predetermined angle by which said microholes of said porous section is inclined ranges approximately from 0 to 45 degrees.

110. The catheter of claim 108 wherein a size of said microholes is in a range approximately from 5 microns to 125 microns.

111. The catheter of claim 110 wherein said size of said microholes is approximately 50 microns.

112. The catheter of claim 84 further including a restrictor at a distal end thereof contiguous with said porous section, said restrictor comprising a spherical cap defining a cavity therein and an opening at a distal end thereof and also a plurality of microholes on a proximal side thereof.

113. The catheter of claim 112 wherein said microholes of said porous section are inclined by a predetermined angle in a proximal direction such that the forces of fluid flowing from within said catheter out of said opening of said restrictor and out of said microholes of said porous section and said spherical cap substantially balance thereby substantially

stable while the fluid is finely dispersed therefrom.

114. The catheter of claim 113 wherein said predetermined angle by which said microholes of said porous section is inclined ranges approximately from 0 to 45 degrees.

115. The catheter of claim 113 wherein said predetermined angle by which said microholes of said porous section is inclined changes with position along said stem.

116. The catheter of claim 113 wherein a size of said microholes is in a range approximately from 5 microns to 125 microns.

117. The catheter of claim 116 wherein said size of said microholes is approximately 50 microns.

118. An injector system comprising:

(a) an injector for injecting a fluid into a patient; and

(b) a catheter operably associated with said injector for introducing the fluid into a bodily structure, said catheter comprising:

(I) a porous section; and

opening therein whose size generally decreases as pressure of fluid within said restrictor increases.

119. The injector system of claim 118 wherein said porous section defines a plurality of microholes distributed thereabout and inclined by a predetermined angle in a proximal direction.

120. The injector system of claim 118 wherein said restrictor comprises a conically-shaped valve with an apex thereof pointing in the proximal direction and defining an opening whose size generally decreases as pressure of the fluid within said tip increases.

121. The injector system of claim 118 wherein the forces of the fluid flowing out of said opening and said porous section substantially balance to allow said catheter to remain stable within the bodily structure.